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A CROSS-SECTIONAL MODEL OF ANNUAL INTERREGIONAL MIGRATION AND EMPLOYMENT GROWTH: INTERTEMPORAL EVIDENCE OF STRUCTURAL CHANGE, 1958-1975

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A CROSS-SECTIONAL MODEL OF ANNUAL INTERREGIONAL MIGRATION AND EMPLOYMENT GROWTH: INTERTEMPORAL EVIDENCE OF STRUCTURAL CHANGE, 1958-1975.

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I. Introduction

The empirical literature on interregional migration, particularly that concerned with migration within the United States, is almost exclusively focused on cross-sectional studies. The reason for this lack of attention to time-series analyses is that until recently appropriate time series data on migration within the U.S. were simply nonexistent. In the present study we use recently developed annual data on migration, employment, and earnings for 171 regions and for 18 years to examine changes in the structure of a model of annual interregional migration and employment change.

The model developed in this study is set up in such a way as to yield insight into an elusive question in migration analysis, namely, how many additional jobs does one more employed net migrant mean to a region? A subsidiary question is how many incremental jobs are required to attract one more net migrant. We show that the answers to these questions vary from year to year, and they also vary by type of region. In addition to considering the interrelationships between migration and employment change, we also consider those between migration and (average) earnings change. Our study actually yields estimates of the impacts that an additional migrant has on average annual earnings within a region.

Because the available data had much to do with shaping the model used here, the data are briefly discussed in Section II. The model is presented in Section III, and the empirical results are given in Section IV.

II. The Data

The migration data utilized in this study are derived from a one-percent sample of all persons employed in Social Security-covered jobs during each year from 1958 to 1975. While the One-Percent Social Security Continuous

Work History Sample (CWHS) has been available for many years, all of the data contained in the file were never put on an annual basis until done so for this project. The data are therefore unique. They are the only available U.S. data that yield an annual measure of migration for a reasonably long period of time and that also have nationally inclusive spatial detail. The spatial unit is the Bureau of Economic Analysis (BEA) Economic Area. The coterminous U.S. is divided into 171 such areas, and each area is supposed to delineate a labor market. Hence, 171 observations are available for each of 18 years. Migration refers to a change during the course of a year in the BEA Economic Area in which an individual's place of work is located, as reported by his employer. All migration, therefore, relates to employed persons.

Employment and earnings data are also from the CWHS and are consistent with the migration data. Change in area employment during a given year (ΔE_{it}) is the difference between an area's Social Security employment at the end of the year and that area's Social Security employment at the beginning of the year. Change in average earnings (ΔW_{it}) is the difference between end-of-period and beginning-of-period average annual earnings of persons in Social Security-covered employment in the area. Mutually consistent employment and earnings data are also available for 10 industrial categories, which correspond to one-digit SIC code industries (plus a catchall industry termed "unclassified").

The CWHS data are not without their shortcomings. One problem that must be recognized is that only employment and earnings data are available. Annual measures of other economic variables of potential importance in explaining migration, such as unemployment rates, are nonexistent for the period of time under study. A second problem is that to be counted as a migrant, a person must be employed in a Social Security covered job at both

the beginning and the end of the year. As pointed out by McCarthy and Morrison (1977), this problem biases migrants in favor of those who are economically more successful. Other characteristics of the CWHS are discussed in detail in the U.S. Department of Commerce (1976a).

III. The Model

The nature of the model specified in this study is shaped by two considerations. The first is our twin objectives of (a) ascertaining the absolute amount of net migration caused by an additional job and (b) determining the absolute employment impact of an additional migrant. The second is the available data, which are not abundant in terms of variables and which therefore limit us to a fairly simple model.

The model is simultaneous, with the basic simultaneity running between absolute net in-migration to area i during period $t(NM_{it})$ and absolute employment change in i during $t(\Delta E_{it})$:

$$NM_{it} = f(\hat{\Delta E}_{it}, \ldots), \; f_1 > 0, \tag{1}$$

and

$$\Delta E_{it} = g(\hat{NM}_{it}, \ldots), \; g_1 > 0. \tag{2}$$

While the latter relationship has an oral history, few attempts have been made to directly measure it. Muth's studies (1968, 1971) are possible exceptions, but his models differ from ours in a number of ways.

Clearly, $(\partial NM_{it}/\partial \Delta E_{it})$ is also expected to be positive. Employment growth should reflect expanding job opportunities and should therefore be attractive to (net) migrants. $(\partial \Delta E_{it}/\partial NM_{it})$ is also expected to be positive because net in-migration causes both labor supply and labor demand to increase, while net out-migration causes both to decrease.

Even if $g_1 > 0$, however, we do not know whether net in-migration results

in increased or decreased employment among an area's indigenous residents. Either outcome is possible. If we assume that the net migrant is employed, as those in our data base are, then $g_1 > 1$ implies an increase in employment of indigenous residents, while $0 < g_1 < 1$ implies a decrease in employment of indigenous residents, or substitution of migrant for indigenous labor. Finally, if $g_1 = 1$, no change occurs in employment of indigenous residents, and area employment increases by exactly the amount of the migrant's contribution to employment. Muth interprets his findings as indicating this third possibility.

Apart from the data contained in the CWHS, very little information is available on all 171 BEA Economic Areas for all 18 years.[1] This lack of data makes formulation of a very simple, two-equation model of the sort described earlier quite questionable because few exogenous variables can be specified that operate on employment without also operating on migration, which means that identification of each equation is troublesome. To circumvent this problem we have specified a model with industry-specific employment change. Eight endogenous industry categories are identified, and each industry-specific employment equation contains industry-specific explanatory variables from the CWHS. The result is that each equation in the model is overidentified. The impact of migration on industry-specific employment change is, moreover, of some interest in itself.

In a model that focuses on particular categories of local labor demand and supply and also assumes equilibrium within each of these submarkets, either employment or wage rates must be chosen for particular attention, but not both. Consider a simple, equilibrium model of the local market for labor in industry j at time t. (Occupational categories would be superior to industrial categories, but are nonexistent in the CWHS.)

$$Q^D_{ijt} = a_o + a_1 W_{ijt} + a_2 Y_{it} + \dots \qquad \text{(demand equation)} \qquad (3)$$

$$Q^S_{ijt} = b_o + b_1W_{ijt} + b_2P_{it} + \ldots \qquad \text{(supply equation)} \qquad (4)$$

$$Q^D_{ijt} = Q^S_{ijt} \qquad \text{(equilibrium condition)} \qquad (5)$$

where Q^D_{ijt} and Q^S_{ijt} refer, respectively to the quantity of labor demanded by and supplied to industry j in area i, at time t. W_{ijt} is the industry-specific wage prevailing in the area, and Y_{it} and P_{it} are shifter variables that might relate, respectively, to income and population, for example.

If the structure of the model is assumed to remain stable over the period, then an identical model might have been specified with (t-1) subscripts, where (t-1) indicates the beginning of the period. Subtracting beginning-of-period values from corresponding end-of-period values yields an equilibrium model expressed in terms of first differences:

$$\Delta Q_{ij} = a_1(\Delta W_{ij}) + a_2(\Delta Y_i) + \ldots \qquad (6)$$

$$\Delta Q_{ij} = b_1(\Delta W_{ij}) + b_2(\Delta P_i) + \ldots \qquad (7)$$

Since equilibrium is presumed to prevail, the D and S superscripts can be dropped, and the system reduces to two equations in two unknowns, ΔQ_{ij} and ΔW_{ij}.

Note that Equation (7) can now be subtracted from Equation (6), with the result that ΔQ_{ij} falls out of the system, which can in turn be solved for ΔW_{ij}. Similarly, ΔW_{ij} might have been eliminated from the system, and the equivalent of a reduced form equation for ΔQ_{ij} might have been developed. The equilibrium nature of the model suggests that either quantity (i.e., employment) change or wage change be utilized as a dependent variable, but not both. Some degree of arbitrariness exists regarding which orientation is selected for analysis. We have estimated the model each way, but present

only the findings associated with the industry-specific employment-change version, which yields considerably stronger results.

The employment change version of the model probably yields better results because migration tends to shift labor demand and supply curves in the same direction, thus causing an unequivocal change in employment in that direction, but causing offsetting changes in wage levels. Muth (1968) also finds that his results for a wage-change equation are much poorer than those for an employment-change equation. While industry-specific wage changes are not considered in the model presented here, area-wide wage changes are taken into account because along with area-wide employment changes, they determine area change in aggregate earnings, which is our proxy for area income change.

The model consists of 12 equations and 12 endogenous variables. Ten equations are structural and two are identities. The structural equations are for absolute net in-migration (NM_{it}), absolute industry-specific employment change (ΔE_{ijt}), where $j = 1, \ldots, 8$, and absolute change in earnings per worker during year t (ΔW_{it}). Identities for total area employment change (ΔE_{it}) and for total area earnings change (ΔY_{it}) close the system. Let us in turn consider each equation.

The Migration Equation

Research undertaken by economists has typically placed much emphasis on economic considerations as motivational factors that influence the decisions regarding whether and where to migrate. In recent years a number of economists, such as Graves (1979) and Liu (1975), have demonstrated that certain regional amenities are also important in determining the direction and magnitude of migration. We have attempted to account for each type of

factor by specifying a migration equation of the following form:

$$NM_{it} = f(EC_{it};\ A_{it}), \tag{8}$$

where EC_{it} is a vector of economic variables defined for area i during period t, and A_{it} is a vector of amenity varibles defined for i during t.

Three economic variables are used to explain net migration, namely, employment change ($\hat{\Delta E}_{it}$), change in earnings per worker ($\Delta\hat{W}_{it}$), and earnings per worker at the beginning of the year (W_{it-1}). Each variable should have a positive coefficient.

Five climatological variables are included in the analysis as regional amenities. In a study that also seeks to explain net migration, Graves (1979) has obtained reasonably convincing results using these same five amenities, and we have therefore followed his innovative work. The variables are annual heating degree days (HD_i), annual cooling degree days (CD_i), temperature variance ($TVAR_i$), and two variables that enter respectively into comfort and wind-chill indexes, namely, humidity (HUM_i) and wind speed ($WIND_i$). These last two variables are defined as annual average daily readings.[2] Each amenity variable is assumed to be invariant with respect to time. Graves suggests that if individuals prefer either a cold or a warm climate, but not much temperature variance, then HD_i and CD_i should take positive signs, while $TVAR_i$, HUM_i, and $WIND_i$ should take negative signs. Objections might be raised to some of Graves' reasoning, especially regarding HD_i and $TVAR_i$, but we do not pursue these objections.

The Employment Equations

As pointed out previously, employment change has been disaggregated into eight endogenous industry categories. The eight industries are: (1)

construction, (2) manufacturing, (3) transportation, communication, and public utilities, (4) trade, (5) finance, insurance, and real estate, (6) services, (7) government, and (8) unclassified. Agriculture and mining are treated as exogenous, in part because earnings data for these industries are incomplete for certain regions. In no year between 1957 and 1974 did the fraction of Social Security covered employment in agriculture and mining exceed four percent.

The employment growth equations are of the following form:

$$\Delta E_{ijt} = g_j(\hat{NM}_{it}, \hat{\Delta Y}_{it}, E_{ijt-1}, W_{ijt-1}, \Delta MIL_{it}, PNF_i, COAST_i, ISHWY_i), \quad j = 1, \ldots, 8 \tag{9}$$

$$\Delta E_{it} = \sum_{j=1}^{8} (\Delta E_{ijt}) + \Delta AGR_{it} + \Delta MINING_{it}. \tag{10}$$

ΔY_{it} is absolute change in area Social Security covered earnings, which should rather closely reflect change in area income. E_{ijt-1} and W_{ijt-1} are, respectively, industry-specific employment and industry-specific mean annual earnings at the beginning of the period. ΔMIL_{it} is change in military earnings, which is intended to reflect the exogenous influences of changed emphasis on military installations. PNF_i is the percentage of the region's land area that is in national forests and grasslands.[3] $COAST_i$ is a dummy variable that takes a value of one if the region has a sea coast, and otherwise zero. $ISHWY_i$ is a dummy variable that takes a value of one for regions in which an interstate highway passes through the centroid city and intersects another interstate highway within the region, and otherwise zero. This latter variable has been defined for 1960 (1955-1963), 1965 (1964-1968), 1970 (1969-1973), and 1975 (1974-1975).

As we argued previously, NM_{it} should take a positive sign in each employment change equation. ΔY_{it}, which should reflect changes in area aggregate demand, should also have a positive sign. Industry-specific employment levels should serve as crude proxies for scale and agglomeration economies. If high industry employment levels indeed reflect such economies, and thus choice investment opportunities, industry employment growth should be greater where industry employment levels are higher. We specify no a priori sign on the variable for industry-specific wage level, but include the variable as a measure of unit labor costs. For certain industries low labor costs might be attractive.

Certain of the BEA Economic Areas have over 50 percent of their land area in national forests or grasslands. Since industrial and residential development is somewhat restricted on such federal lands, PNF_i has been included as a control variable. The coast and interstate highway dummies are included as crude indicators of transportation advantages that should lead to greater employment growth.

The Wage and Income Equations

The remaining equations in the system are for area change in earnings per worker (ΔW_{it}) and area change in aggregate earnings (ΔY_{it}):

$$\Delta W_{it} = h(\hat{NM}_{it}, \hat{\Delta Y}_{it}, E_{it-1}, W_{it-1}, \Delta MIL_{it}, PNF_i, COAST_i, ISHWY_i), \qquad (11)$$

$$\Delta Y_{it} = W_{it-1}(\Delta E_{it}) + E_{it-1}(\Delta W_{it}) + (\Delta W_{it})(\Delta E_{it}). \qquad (12)$$

The wage-change equation is symmetrical with the employment-change equations, except that total area employment at the beginning of the period (E_{it-1}) is substituted for industry-specific employment change. This symmetry is sug-

gested by our previous discussion of Equations (3) - (7).

The expected effect of net migration on wage change is ambiguous. Greater net in-migration increases labor supply, which in itself tends to depress local wage rates. However, greater net in-migration also increases labor demand, which in itself tends to raise local wage rates. Since the two effects tend to offset one another, migration's impact on local wage levels depends upon the relative magnitudes of the labor supply and demand shifts.

Note also that whether migration results in a net increase or a net decrease in an area's wage level is an important determinant of the resulting impact that migration has on employment of indigenous residents. If migration results in an increase in the area wage rate, then presumably the labor force participation of indigenous residents will rise as they move up along the indigenous (original) labor supply curve. Consequently, $g_1 > 1$ will result. If, on the other hand, migration results in a decrease in the area wage rate, then presumably the labor force participation of indigenous residents will fall as they move down along the indigenous labor supply curve. Hence, $0 < g_1 < 1$, or substitution of migrant for indigenous labor, will result.

IV. The Empirical Results

The model discussed in Section III has been estimated by ordinary least squares and by three stage least squares. Only the three stage least squares estimates are presented. The residuals associated with the three stage least squares estimates were examined for four years (1961, 1966, 1971, and 1975). Heteroscadasticity does not appear to be a problem of concern, and therefore no attempt was made to correct for it.

Because the empirical results associated with this study are voluminous, we emphasize those findings that relate to the interrelationships between migration and employment change, and to a lesser extent those between migration and change in earnings per worker. Three groups of results are considered. These groups are based on data partitions into areas with large, medium, and small employment levels. Each partition contains 57 observations. To ensure that these partitions are invariant with respect to time, we selected BEA Economic Areas on the basis of average annual employment level over the 18-year period covered by the study.

A number of sound reasons exist for partitioning the data according to area employment size. Central place theory suggests a hierarchy of places that is closely associated with size, where larger places generally provide a wider range of goods and services than smaller places. Leakages of incremental income should therefore be smaller for larger areas because the marginal propensity to import should be lower for these areas. Scale, localization, and agglomeration economies should also operate differentially in areas of different size.

Migration and Employment

Table 1 indicates the coefficients associated with ΔE_{it} in the annual equations for net migration. These coefficients have been estimated by three stage least squares. The coefficients in Table 1 may be interpreted as the estimated number of net migrants attracted to a region with sample mean characteristics by one additional job. Such estimates are reported for each of 18 years between 1958 and 1975 and for large, medium, and small regions.

We emphasize that the results presented here are preliminary because at this writing all data problems have not been resolved. Due to the

preliminary nature of the results, in the discussion that follows we discuss average annual values of the various coefficients. At a later date we anticipate utilizing more sophisticated methods of handling problems associated with pooling cross-sectional and time-series data, but at this time the use of such methods is premature. These methods will allow us to derive statistically more valid "average" results.

The attractive power of additional jobs is clearly evident in the results presented in Table 1. When the data are partitioned by size class, 52 of 54 annual coefficients are positive, and 50 of these 52 are significant at somewhat better than the 2.5-percent level.

The mean values of the coefficients suggest that in large regions one additional job, on the average, attracted 0.2387 additional net in-migrants, or every 4.2 extra jobs attracted one more net migrant. However, only 2.2 additional jobs were required to attract another migrant to medium-sized regions, and 2.1 jobs were required in small regions. If these results are reasonable, and their orders of magnitude seem to be, they suggest that an extra job in a large area tends to be filled more by indigenous residents than by migrants, presumably through some combination of decreased unemployment and increased labor force participation. In smaller areas, however, migration plays a relatively more important role in satisfying any given increase in labor demand. These results may be due in part to the large pool of potential labor supply in large areas.

Note too that for each type of region substantial year-to-year fluctuations occur in migration's responsiveness to increased employment opportunities, though the fluctuations are absolutely and relatively greater for large regions. The standard deviation in the annual estimates for large regions is 69-percent higher than that for medium regions and 43-percent higher than that for small regions. The coefficient of variation is 0.8852 for large regions compared to

0.2724 for medium and 0.3139 for small regions. Moreover, for large regions the relationship appears to have changed markedly over time. During the 1970-75 period an average of 2.5 extra jobs were required to attract one more migrant, compared to an average of 4.6 extra jobs during the 1958-63 period. Medium and small regions did not experience as sizeable an average change, and during the later period all three types of regions were quite similar in their behavior.

Since the extra job that is under consideration here is an actual job that must have been filled, conversely large year-to-year fluctuations must have occurred in local responses to employment growth. These fluctuations, of course, amount to changes in the structure of the migration model through time. The question that naturally arises is why model structure experiences the observed year-to-year changes. In an attempt to explain these annual changes in migration's responsiveness to increased employment, we have considered a number of national forces with which migration responsiveness may be associated. The model we have estimated is of the following form:

$$\beta_{dE_t} = f(\Delta GNP_t, \Delta GNP_{t-1}, CV_{dE_t}, CV_{dE_{t-1}}, e) \tag{13}$$

where

β_{dE_t} = coefficient on dE_t in the NM equation for year t;

ΔGNP_t = change in GNP, measured in 1967 prices during year t;

ΔGNP_{t-1} = the above variable lagged one year;

CV_{dE_t} = coefficient of variation in employment change across all BEA Economic Areas during year t; and

$CV_{dE_{t-1}}$ = the above variable lagged one year.

We expect a positive sign on ΔGNP_t. During expansionary periods more mobility should occur in response to improved job opportunities as workers seek to better their positions. We also expect a positive sign on dCV_{dF_t} because as the dispersion of incremental jobs increases around the mean, the opportunity cost of remaining in a given location increases.

The appropriate method of estimating Relationship (13) is Generalized Least Squares. The weights are the standard errors associated with the various estimates of ΔE_{it} in the net-migration equation.[4] The estimates of (13) are presented in Table 2. The model yields reasonably good results for large and for small regions, but not for medium-sized regions. For both large and small regions the contemporaneous coefficient of variation in changed employment opportunities is positive and highly significant, which indicates that in years when employment opportunities are relatively dispersed, responsiveness to such opportunities is greater. Moreover, lagged ΔGNP is positive and highly significant for small places.

Tables 3, 4, and 5 present the estimated change in industry-specific employment due to one additional net migrant. These tables refer, respectively, to the manufacturing, trade, and service industries. At the beginning of [illegible] these three industries accounted for almost 76 percent of total Social Security covered employment, which is the reason that we focus on them.[5]

When the impacts of migration on employment growth are compared across the three classes of regions, the effects are found to be greatest in large regions and least in small regions. The mean values suggest that in an average year an additional net in-migrant to a large region induces over twice as many manufacturing jobs (0.4787) as an additional net in-migrant to a small region (0.1988). For trade employment the difference between large (0.3052) and small

regions (0.2149) is not quite so evident, but for service employment the difference is marked (0.2793 versus 0.0442). As might be expected, the mean values decline monotonically across the three size classes.

As an approximation of the total impact on employment due to one more net in-migrant, we have calculated the 18-year average for the industries that were ignored in our earlier treatment. These industries are construction, transportation-communication-public utilities, government, finance-insurance-real estate, and unclassified. For no one of these industries is the employment effect of migration particularly large. This statement holds for each of the size classes.

When the coefficients are summed across all eight industries, the resulting estimates are as follows: large regions, 1.3075; medium regions, 0.8373; and small regions, 0.5416. Recall that the measure of migration utilized in this study refers to employed persons. Thus, in large regions, for example, one more net in-migrant results in approximately 1.3 more jobs, but one of these is held by the migrant himself. Thus 0.3 of a job is induced among others in the region. In small regions, however, an additional employed in-migrant results in an increase of only about 0.5 of a job, which means that the migrant substitutes for about 0.5 of an indigenous resident.

In an examination of the same five climatological amenities that we have considered here, Graves (1979) has recently found that net migration over the decade of the 1960s was significantly associated with these amenities. He concludes that, ceteris paribus, migrants were attracted to both warm and cold places, but were repulsed by high temperature variance, high humidity, and wind. Our results are somewhat different than those of Graves. To our surprise, the amenity variables are rarely significant. For large places 27.8 percent of the amenity coefficients had absolute t-values in excess of 1.7,

compared to 10.0 percent for medium places and 20.0 percent for small places. However, for large places only 7.8 percent of the coefficients had both the same sign obtained by Graves and such absolute t-values, compared to 7.8 percent for medium places and 18.9 percent for small places. On the other hand, the results associated with the economic variables utilized in our study appear to be much stronger than those obtained by Graves.

Another coefficient of some interest is the industry-specific average earnings level in the industry-specific employment change equations. An hypothesis frequently advanced for the differentially high rates of employment growth, particularly manufacturing employment growth, in the South and the West relative to the Northeast and North Central regions is that low unit labor costs are available in the former areas. When the coefficients are compared across all three size classes of regions and across all industries, roughly the same fraction of coefficients is negative (46 percent) as positive (54 percent). Less than 27 percent of the coefficients are significant at 10-percent (when a two-tail test is applied). However, some tendency is evident for manufacturing and construction employment to grow most where wage levels in these industries are low, and the tendency is evident within each size class. High wages apparently have some tendency to encourage the growth of employment in the transportation, communication, and public utilities industry, as well as in finance, insurance, and real estate and in government. No discernable trend is evident in the significance of wage levels in encouraging employment growth in any of these industries.

Each industry-specific employment change equation contains as an explanatory variable change in area income. This variable is typically positive and is often significant. It might be argued that certain of the demand effects of migration may be transmitted through the incremental income

associated with migration. If this were the case, the migration variable itself would not capture the full effects of migration, and the estimates we present here would thus be biased downward.

Migration and Earnings

Table 6 summarizes the results associated with ΔW_{it} in the net migration equation. The coefficients reported in Table 6 indicate the number of net migrants attracted to a region by a one-dollar increase in average annual earnings. Over the entire 18-year period the results associated with ΔW_{it} are quite mixed, with substantial year-to-year fluctuations in both signs and significance levels. For example, in the regressions for large regions the coefficient on ΔW_{it} is positive and significant for five years, but is actually negative with an absolute t-value of greater than 2.0 for three years.

Fairly substantial differences also exist between large regions compared to medium and especially compared to small regions. Increased money earnings tended to result in net in-migration to small regions. For eight years the coefficient on ΔW_{it} is positive and highly significant for small areas. The coefficient is negative with an absolute t-value in excess of 2.0 for only two years.

One possible explanation for the negative signs that appear on ΔW_{it} is that increased money earnings are serving in part to compensate for increased disamenities associated with living in certain types of places at certain times. Increased pollution, congestion, and crime are examples of such disamenities that could be associated with increased size of an area. If the increase in money earnings were to completely compensate for the increase in disamenities, out-migration would not be expected. However, if the increase in money earnings fails to compensate completely for the increased disamenities, places with greater growth of money earnings could experience out-migration because real

earnings would have fallen, ceteris paribus.

McCarthy and Morrison (1977) recently used the CWHS to examine the relationship between earnings per worker and net migration to nonmetropolitan counties over the 1971-73 period. They find that counties with lower earnings levels actually had greater net in-migration. Our results show a good deal of contrast between large and small areas. The coefficient on W_{it-1} for large regions is more frequently negative and significant at better than 10 percent (5 years) than positive and significant at 10 percent (3 years). However, the coefficient for small areas is generally psoitive and significant (10 years) and is never negative and significant at even 10 percent. Two of the six years for which the coefficient is negative for small regions are 1972 and 1973, which may suggest that McCarthy and Morrison's results are not generalizable.

Table 7 reports the coefficients on the net-migration variable in the equation for change in average annual earnings. These coefficients may be interpreted as the change in such earnings caused by one additional net in-migrant. Migration's impact on mean earnings levels is generally negative and is somewhat greater for smaller than for larger regions. For all regions taken as a whole, the coefficient on NM_{it} is, for seven different years, negative and has an absolute t-value in excess of 2.0. The coefficient is positive with such a t-value for three years. For medium and small regions net in-migration has uniformly depressing effects on mean annual earnings. For 16 of 18 years medium regions have a negative coefficient and for 15 of these 16 years the absolute t-value exceeds 2.0. For small regions the coefficient is negative for every year and the absolute t-value exceeds 2.0 for 13 years.

The results suggest that in 1975, for example, one additional net in-migrant in small areas resulted in a $5.19 decrease in average annual earnings.

Such a decrease, while statistically significant, amounted to 0.00095 percent of average annual earnings (in small regions) at the beginning of 1975. Moreover, this \$5.19 decrease suggests that regional wage payments measured at the beginning-of-period level of employment fell by \$5,717 due to one more net in-migrant.

Note that this decrease in wage payments does not necessarily mean that the region's annual wage bill declined, because migration also contributes to increased employment. In 1975 migration to small regions resulted in a good deal of displacement of native workers such that the increase in area total employment due to one more migrant was only 0.137 jobs. (Since the migrant himself was employed, this estimate suggests that 0.863 of a local person who would otherwise have been employed was not so employed.) In part because of the small factor by which employment increased due to net in-migration, wage payments increased by only about \$750 due to the employment increase associated with migration. Thus, in 1975 net migration to small regions had the consequence of reducing the region's wage bill by approximately \$4,967 per migrant. Note also that this negative figure does not indicate that migration caused the region's income level to fall, because the returns to other factors should rise due to in-migration. Actually, the \$5,717 mentioned above would accrue to non-labor factors of production and to consumers.

By way of contrast, in 1975 large regions had quite sizeable impacts of migration on employment, such that the increase in their wage bill due to increased employment caused by migration outweighted the decrease in the wage bill due to decreased average earnings levels. The result was that a net migrant to a large area resulted in a net increase in the area's wage bill of about \$12,544. Of course, if the migrant were to leave such an area, the area's wage bill would decline by this magnitude. The absolutely greater impacts associated

with net migration to larger areas may be due in part to more extensive interindustry linkages in such areas. In part these results may also be due to the higher earnings required to attract a migrant to a large area.

Keep in mind that the figures presented above are due to the estimated effects of net migration, other factors held constant. These other factors may in fact have changed appreciably enough to far outweigh the effects of migration, as well as to conceal these effects. In interpreting the behavior over time of the coefficients presented in Table 7, the reader should also keep in mind that the values shown are money values. Due to the generally rising level of prices over the 1958-1975 period, corresponding real values would presumably be somewhat lower in absolute value.

V. Summary and Conclusions

In the context of a fairly simple simultaneous-equations model of migration and employment change, and using a new and unique data base, we have estimated the migrant attractive power of an *additional* job and the number of jobs induced by an additional migrant for each year from 1958 to 1975. These relationships have been estimated for areas with absolutely large employment size, as well as for those of intermediate and small size. The results are quite preliminary, but they do suggest appreciable differences in the magnitudes of the relationships between larger and smaller areas. Fewer incremental jobs are required to attract an additional migrant to small areas; moreover, fewer incremental jobs are induced in small areas by an additional migrant. Considerable year-to-year changes are also evident in the magnitudes of the relationships.

Higher per worker earnings levels and earnings growth tend to attract migrants to smaller areas, but the migrants in turn tend to depress wage levels in these areas, ceteris paribus. Certain types of employment, namely manu-

facturing and construction, are attracted to low-wage areas, while other types are attracted to high-wage areas. These latter relationships, however, are not particularly strong. Finally, climatological amenities have had surprisingly little influence on annual migration flows.

Footnotes

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[1]Another potential source of annual data on BEA Economic Areas is the annual estimates of employment and income provided by BEA. However, these data are not available for every year between 1958 and 1975 and therefore require interpolation for certain years. We have used this source for one variable utilized herein, namely, wage and salary disbursements to military personnel (ΔMIL_{it}). Otherwise, we have used migration, employment, and earnings data from the CWHS because of their inherent compatibility.

[2]The source of the climatological data is U.S. Department of Commerce (1976b). Where data are reported as annual averages over long periods of time, such as with heating degree days, we have utilized these measures. Other data, such as cooling degree days, have a more recent history, and these we defined for 1975.

[3]The source of these data is U.S. Department of Agriculture (1978) and U.S. Department of Commerce (1978).

[4]See Saxonhouse (1976).

[5]These percentages were as follows: manufacturing, 27.2; trade, 24.3; and services, 24.2.

References

Graves, Philip E., "A Life-Cycle Empirical Analysis of Migration and Climate, by Race," Journal of Urban Economics, 6, April 1979, 135-147.

Liu, Ben-chieh, "Differential Net Migration Rates and the Quality of Life," Review of Economics and Statistics, 57, August 1975, 329-337.

McCarthy, Kevin F., and Peter A. Morrison, "The Changing Demographic and Economic Structure of Nonmetropolitan Areas in the United States," International Regional Science Review, 2, Winter 1977, 123-142.

Muth, Richard F., "Differential Growth Among Large U.S. Cities," in Papers in Quantitative Economics, ed. by J. P. Quirk and A. M. Zarley (Lawrence: The University Press of Kansas, 1968), 311-355.

_______________, "Migration: Chicken or Egg," Southern Economic Journal, 37, January 1971, 295-306.

Saxonhouse, Gary R., "Estimated Parameters as Dependent Variables," American Economic Review, 66, March 1976, 178-183.

U.S. Department of Agriculture, Forest Service, "Land Areas of the National Forest System, as of 9/30/77," (Washington, D.C.: U.S. Government Printing Office, 1978).

U.S. Department of Commerce, Bureau of Economic Analysis, Regional Work Force Characteristics and Migration Data (Washington, D.C.: U.S. Government Printing Office, 1976a).

__________________________, National Oceanic and Atmospheric Administration, "Climatological Data: National Summary," vol. 26, Nos. 1-13 (Washington, D.C.: U.S. Government Printing Office, 1976b).

________________________, U.S. Bureau of the Census, County and City Data Book, 1977 (Washington, D.C.: U.S. Government Printing Office, 1978).

TABLE 1

Estimated Number of Net Migrants Attracted by

One Additional Job, 1958-1975

Year	Size of Region		
	Large	Medium	Small
1958	-0.1052**	0.5683**	0.2193**
1959	0.1566**	0.3311**	0.4193**
1960	0.1953**	0.6465**	0.4412**
1961	0.5073**	0.4344**	0.5833**
1962	0.2824**	0.3312**	0.3855**
1963	0.2570**	0.3764**	0.6990**
1964	0.2644**	0.5733**	0.2805**
1965	0.0550*	0.3647**	0.2889**
1966	0.0306	0.4348	0.2974
1967	0.3105**	0.5802**	0.6220**
1968	0.0417	0.4828**	0.5417**
1969	-0.1418**	0.6963**	0.4902**
1970	0.5635	0.4990**	0.6047**
1971	0.4645**	0.5782**	0.4617**
1972	0.2305**	0.2747**	0.4848**
1973	0.2378**	0.3841**	0.4752**
1974	0.5848	0.3506	0.7557
1975	0.3610**	0.3325**	0.4080**
Mean (18 yrs.)	0.2387	0.4577	0.4699
S. Dev. (18 yrs.)	0.2113	0.1247	0.1475
Coef. of var.	0.8852	0.2724	0.3139

**(*) Indicates that absolute value of $t \geq 2.00$ (1.67).

TABLE 2

The Responsiveness of Net Migration to Employment Changes, 1958-1975: Generalized Least Squares Estimates

Independent Variable	Size of Region		
	Large	Medium	Small
ΔGNP	0.0006	-0.0026	-0.0010
	(0.490)*	(1.788)	(0.802)
ΔGNP, lagged	0.0014	-0.0001	0.0040
	(1.204)	(0.077)	(3.320)
$CV_{dE_{it}}$	0.0450	-0.0037	0.0163
	(4.648)	(0.437)	(2.422)
$CV_{dE_{it}}$, lagged	0.0137	0.0025	0.0067
	(1.426)	(0.284)	(1.163)
$s.e.^{-1}$	-0.0860	0.5444	0.2844
	(0.997)	(6.210)	(3.721)
R^2	0.714	0.497	0.717

*Values in parentheses are absolute t-ratios.

TABLE 3

Estimated Change in Manufacturing Employment Due to One

Additional Net Migrant, 1958-1975

Year	Size of Region: Large	Medium	Small
1958	-0.3498	0.2595	0.2063
1959	0.6203**	0.1265	-0.3576**
1960	-0.0977	0.1257	0.3938**
1961	0.2639**	0.5962**	0.6161**
1962	1.2065**	0.6801**	0.2440
1963	0.3081	0.2989	0.6444**
1964	0.4641**	0.2814	0.3059
1965	0.0252	0.2359	0.0949
1966	0.1133	-0.1941	-0.1528
1967	0.5840**	0.0291	0.4147**
1968	0.6315**	0.0760	0.5254**
1969	0.6302**	0.3433*	0.3698*
1970	0.6042**	0.3096	-0.0702
1971	0.3042**	0.2940*	0.1587
1972	0.8304**	0.3486*	0.4190**
1973	1.3274**	0.3339**	-0.4199**
1974	0.3493*	0.2229	0.0846
1975	0.8011**	0.3733**	0.0967
Mean (18 yrs.)	0.4787	0.2634	0.1988
S. Dev. (18 yrs.)	0.4237	0.1969	0.3050
Coef. of var.	0.8851	0.7475	1.5342

TABLE 4

Estimated Change in Trade Employment Due to One

Additional Net Migrant, 1958-1975

Year	Size of Region		
	Large	Medium	Small
1958	0.2645**	0.2798	0.5892**
1959	0.6815**	0.0914	1.0275**
1960	0.1972**	0.1849	-0.1200
1961	0.1312	0.0676	-0.4309*
1962	0.8413**	0.8535**	0.1982
1963	0.5234**	-0.0342	0.7417**
1964	0.0430	0.1649	-0.4964**
1965	0.2335*	0.0379	-0.0771
1966	0.2683	0.2656	-0.0549
1967	-0.0048	0.1831	0.1788
1968	0.0164	0.5658**	0.1552
1969	0.1853**	0.0567	0.1686
1970	0.3000**	0.6190**	0.2156
1971	0.8226**	0.5706**	0.1303
1972	0.3723**	0.3029**	0.4757**
1973	0.0324	0.2284**	0.5700**
1974	-0.1862	0.5619	0.2938**
1975	0.7720**	0.3385**	0.3024**
Mean (18 yrs.)	0.3052	0.2966	0.2149
S. Dev. (18 yrs.)	0.3063	0.2439	0.3830
Coef. of Var.	1.0036	0.8223	1.7822

TABLE 5

Estimated Change in Service Employment Due to One

Additional Net Migrant, 1958-1975

Year	Size of Region		
	Large	Medium	Small
1958	-0.1464	0.0730	-0.2016
1959	0.3656**	0.2042**	-0.0650
1960	0.3277**	0.0202	0.3384**
1961	0.1584*	0.2865	0.5003**
1962	0.4244**	-0.1535	0.0413
1963	-0.0937	0.2444	-0.1193
1964	0.2352**	0.1178	0.0427
1965	0.5933**	0.6186**	-0.1420
1966	0.2288**	0.4394**	-0.3761**
1967	0.5191**	0.1542	0.3256**
1968	0.4343**	0.1505	-0.0989
1969	0.0722	-0.1244	0.0078
1970	-0.1032	-0.0162	0.0981
1971	0.3028**	0.0741	-0.2994
1972	0.8822**	0.6417**	0.0700
1973	0.3689**	0.2628**	0.6016**
1974	0.2230	-0.2307	0.2343*
1975	0.2344**	0.0266	-0.1622
Mean (18 yrs.)	0.2793	0.1550	0.0442
S. Dev. (18 yrs.)	0.2563	0.2392	0.2676
Coef. of var.	0.9177	1.5432	6.0543

TABLE 6

Estimated Number of Net Migrants Attracted by a One-Dollar Increase in Average Annual Earnings, 1958-1975

Year	Size of Region		
	Large	Medium	Small
1958	0.5189**	-0.2205**	-0.0417*
1959	-0.3555**	0.1870**	0.0329
1960	-0.0045	-0.0988*	0.0644**
1961	-0.5566**	0.0922	0.0765**
1962	0.3616**	-0.0008	0.0486**
1963	0.6973**	0.0924**	0.0486**
1964	0.1109	-0.0490	0.0775**
1965	0.0816	0.1762**	-0.0219
1966	-0.3350	-0.1578**	0.0541**
1967	0.8188**	0.0507	0.0142
1968	-0.2802	-0.0190	0.0683*
1969	2.5316**	0.1352**	0.0468**
1970	-0.1461	0.0570*	-0.0141
1971	-0.2376*	0.0346	0.0789**
1972	-0.8142**	-0.0256	-0.0380*
1973	-0.0571	0.0108	-0.0535**
1974	-0.2513	0.1463**	-0.0432**
1975	-0.0608	-0.0242	-0.0081
Mean (18 yrs.)	0.1158	0.0215	0.0217
S. Dev. (18 yrs.)	0.7392	0.1108	0.0474
Coef. of var.	6.3834	5.1535	2.1843

TABLE 7

Estimated Change in Average Annual Earnings Due to One

Additional Net Migrant, 1958-1975

Year	Size of Region: Large	Medium	Small
1958	0.0990	-1.3510**	-1.8053*
1959	-0.5684**	0.3329	-1.7055**
1960	-0.2077**	-1.8812**	-3.9423**
1961	-0.3927**	-1.1173**	-1.4919
1962	-0.0610	-1.9794**	-0.3714
1963	0.0413	-1.4728**	-4.7452**
1964	-0.4343**	-2.0342**	-0.6724
1965	-0.1061	-0.8589	-1.9506**
1966	-0.4482**	-1.6245**	-2.3421**
1967	0.0955	-1.7457**	-4.1842**
1968	-0.2923**	-2.6593**	-3.3676**
1969	0.2301**	-1.1010**	-2.0443*
1970	-0.1084	-2.2454**	-4.7970**
1971	-0.1888	-2.7044**	-1.1832
1972	-0.4501**	-1.2668**	-6.5914**
1973	-0.4337**	-1.6418**	-5.2034**
1974	-0.4636**	0.5628	-4.3605**
1975	-0.8638**	-4.2873**	-5.1931**
Mean (18 yrs.)	-0.2530	-1.6153	-3.1084
S. Dev. (18 yrs.)	0.2798	1.0859	1.8207
Coef. of var.	-1.1059	-0.6723	-0.5857

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Kassing, David, "Protecting The Fleet," 40 pp., Dec 1977 (Prepared for the American Enterprise Institute Conference on Problems of Sea Power as We Approach the 21st Century, October 6-7, 1977) AD A049 109

PP 211
Mizrahi, Maurice M., "On Approximating the Circular Coverage Function," 14 pp., Feb 1978, AD A054 429

PP 212
Mangel, Marc, "On Singular Characteristic Initial Value Problems with Unique Solutions," 20 pp., Jun 1978, AD A058 535

PP 213
Mangel, Marc, "Fluctuations in Systems with Multiple Steady States: Application to Lanchester Equations," 12 pp., Feb 78, (Presented at the First Annual Workshop on the Information Linkage Between Applied Mathematics and Industry, Naval PG School, Feb 23-25, 1978), AD A071 472

PP 214
Weinland, Robert G., "A Somewhat Different View of The Optimal Naval Posture," 37 pp., Jun 1978 (Presented at the 1976 Convention of the American Political Science Association (APSA/IUS Panel on "Changing Strategic Requirements and Military Posture"), Chicago, Ill., September 2, 1976), AD A056 228

PP 215
Coile, Russell C., "Comments on: Principles of Information Retrieval by Manfred Kochen," 10 pp., Mar 78, (Published as a Letter to the Editor, Journal of Documentation, Vol. 31, No. 4, pages 298-301, December 1975), AD A054 426

PP 216
Coile, Russell C., "Lotka's Frequency Distribution of Scientific Productivity," 18 pp., Feb 1978, (Published in the Journal of the American Society for Information Science, Vol. 28, No. 6, pp. 366-370, November 1977), AD A054 425

PP 217
Coile, Russell C., "Bibliometric Studies of Scientific Productivity," 17 pp., Mar 78, (Presented at the Annual meeting of the American Society for Information Science held in San Francisco, California, October 1976), AD A054 442

PP 218 – Classified

PP 219
Huntzinger, R. LaVar, "Market Analysis with Rational Expectations: Theory and Estimation," 60 pp., Apr 78, AD A054 422

PP 220
Maurer, Donald E., "Diagonalization by Group Matrices," 26 pp., Apr 78, AD A054 443

PP 221
Weinland, Robert G., "Superpower Naval Diplomacy in the October 1973 Arab-Israeli War," 76 pp., Jun 1978 (Published in Seapower in the Mediterranean: Political Utility and Military Constraints, The Washington Papers No. 61, Beverly Hills and London: Sage Publications, 1979) AD A055 564

PP 222
Mizrahi, Maurice M., "Correspondence Rules and Path Integrals," 30 pp., Jun 1978 (Invited paper presented at the CNRS meeting on "Mathematical Problems in Feynman's Path Integrals," Marseille, France, May 22-26, 1978) (Published in Springer Verlag Lecture Notes in Physics, 106, (1979), 234-253) AD A055 536

PP 223
Mangel, Marc, "Stochastic Mechanics of Molecule Ion Molecule Reactions," 21 pp., Jun 1978, AD A056 227

PP 224
Mangel, Marc, "Aggregation, Bifurcation, and Extinction In Exploited Animal Populations*," 48 pp., Mar 1978, AD A058 536
*Portions of this work were started at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, B.C., Canada

PP 225
Mangel, Marc, "Oscillations, Fluctuations, and the Hopf Bifurcation*," 43 pp., Jun 1978, AD A058 537
*Portions of this work were completed at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, Canada

PP 226
Ralston, J. M. and J. W. Mann*, "Temperature and Current Dependence of Degradation in Red-Emitting GaP LEDs," 34 pp., Jun 1978 (Published in Journal of Applied Physics, 50, 3630, May 1979) AD A058 538
*Bell Telephone Laboratories, Inc.

PP 227
Mangel, Marc, "Uniform Treatment of Fluctuations at Critical Points," 50 pp., May 1978, AD A058 539

PP 228
Mangel, Marc, "Relaxation at Critical Points: Deterministic and Stochastic Theory," 54 pp., Jun 1978, AD A058 540

PP 229
Mangel, Marc, "Diffusion Theory of Reaction Rates, I: Formulation and Einstein-Smoluchowski Approximation," 50 pp., Jan 1978, AD A058 541

PP 230
Mangel, Marc, "Diffusion Theory of Reaction Rates, II Ornstein-Uhlenbeck Approximation," 34 pp., Feb 1978, AD A058 542

PP 231
Wilson, Desmond P., Jr., "Naval Projection Forces: The Case for a Responsive MAF," Aug 1978, AD A058 543

PP 232
Jacobson, Louis, "Can Policy Changes Be Made Acceptable to Labor?" Aug 1978 (Submitted for publication in Industrial and Labor Relations Review), AD A061 528

PP 233
Jacobson, Louis, "An Alternative Explanation of the Cyclical Pattern of Quits," 23 pp., Sep 1978

PP 234 – Revised
Jondrow, James and Levy, Robert A., "Does Federal Expenditure Displace State and Local Expenditure: The Case of Construction Grants," 25 pp., Oct 1979, AD A061 529

PP 235
Mizrahi, Maurice M., "The Semiclassical Expansion of the Anharmonic-Oscillator Propagator," 41 pp., Oct 1978 (Published in Journal of Mathematical Physics 20 (1979), pp. 844-855), AD A061 538

PP 237
Maurer, Donald, "A Matrix Criterion for Normal Integral Bases," 10 pp., Jan 1979 (Published in the Illinois Journal of Mathematics, Vol. 22 (1978), pp. 672-681

PP 238
Utgoff, Kathleen Classen, "Unemployment Insurance and The Employment Rate," 20 pp., Oct 1978 (Presented at the Conference on Economic Indicators and Performance: The Current Dilemma Facing Government and Business Leaders, presented by Indiana University Graduate School of Business), AD A061 527

PP 239
Trost, R. P. and Warner, J. T., "The Effects of Military Occupational Training on Civilian Earnings: An Income Selectivity Approach," 38 pp., Nov 1979, AD A077 831

PP 240
Powers, Bruce, "Goals of the Center for Naval Analyses," 13 pp., Dec 1978, AD A063 759

PP 241
Mangel, Marc, "Fluctuations at Chemical Instabilities," 24 pp., Dec 1978 (Published in Journal of Chemical Physics, Vol. 69, No. 8, Oct 15, 1978), AD A063 787

PP 242
Simpson, William R., "The Analysis of Dynamically Interactive Systems (Air Combat by the Numbers)," 160 pp., Dec 1978, AD A063 760

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Simpson, William R., "A Probabilistic Formulation of Murphy Dynamics as Applied to the Analysis of Operational Research Problems," 18 pp., Dec 1978, AD A063 761

PP 244
Sherman, Allan and Horowitz, Stanley A., "Maintenance Costs of Complex Equipment," 20 pp., Dec 1978 (Published By The American Society of Naval Engineers, Naval Engineers Journal, Vol. 91, No. 6, Dec 1979) AD A071 473

PP 245
Simpson, William R., "The Accelerometer Methods of Obtaining Aircraft Performance from Flight Test Data (Dynamic Performance Testing)," 403 pp., Jun 1979, AD A075 226

PP 246
Brechling, Frank, "Layoffs and Unemployment Insurance," 35 pp., Feb 1979 (Presented at the NBER Conference on "Low Income Labor Markets," Chicago, Jun 1978)

PP 248
Thomas, James A., Jr., "The Transport Properties of Dilute Gases in Applied Fields," 183 pp., Mar 1979

PP 249
Glasser, Kenneth S., "A Secretary Problem with a Random Number of Choices," 23 pp., Mar 1979

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Mangel, Marc, "Modeling Fluctuations in Macroscopic Systems," 26 pp., Jun 1979

PP 251
Trost, Robert P., "The Estimation and Interpretation of Several Selectivity Models," 37 pp., Jun 1979, AD A075 941

PP 252
Nunn, Walter R., "Position Finding with Prior Knowledge of Covariance Parameters," 5 pp., Jun 1979 (Published in IEEE Transactions on Aerospace & Electronic Systems, Vol. AES-15, No. 3, March 1979

PP 253
Glasser, Kenneth S., "The d-Choice Secretary Problem," 32 pp., Jun 1979, AD A075 225

PP 254
Mangel, Marc and Quanbeck, David B., "Integration of a Bivariate Normal Over an Offset Circle," 14 pp., Jun 1979

PP 255 – Classified, AD B051 441L

PP 256
Maurer, Donald E., "Using Personnel Distribution Models," 27 pp., Feb 1980, AD A082 218

PP 257
Thaler, R., "Discounting and Fiscal Constraints Why Discounting is Always Right," 10 pp., Aug 1979, AD A075 224

PP 258
Mangel, Marc S. and Thomas, James A., Jr "Analytical Methods in Search Theory," 86 pp., Nov 1979, AD A077 832

PP 259
Glass, David V Hsu, Ih Ching Nunn, Walter R and Perin, David A "A Class of Commutative Markov Matrices," 17 pp Nov 1979, AD A077 833

PP 260
Mangel, Marc S and Cope, Davis K "Detection Rate and Sweep Width in Visual Search" 14 pp Nov 1979, AD A077 834

PP 261
Vila, Carlos L Zvijac David J and Ross John "Franck Condon Theory of Chemical Dynamics VI Angular Distributions of Reaction Products" 14 pp. Nov 1979 *(Reprinted from Journal Chem Phys* 70(12), 15 Jun 1979), AD A076 287

PP 262
Petersen, Charles C. "Third World Military Elites in Soviet Perspective" 50 pp Nov 1979 AD A077 835

PP 263
Robinson, Kathy I "Using Commercial Tankers and Containerships for Navy Underway Replenishment" 25 pp. Nov 1979 AD A077 836

PP 264
Weinland, Robert G "The U S Navy in the Pacific Past, Present, and Glimpses of the Future" 31 pp. *Nov 1979 (Delivered at the International* Symposium on the Sea sponsored by the International Institute for Strategic Studies The Brookings Institution and the Yomiuri Shimbun Tokyo, 16 20 Oct 1978) AD A066 837

PP 265
Weinland, Robert G "War and Peace in the North Some Political Implications of the Changing Military Situation in *Northern Europe*" 18 pp Nov 1979 (Prepared for presentation to the "Conference of the Nordic Balance in Perspective The Changing Military and Political Situation" Center for Strategic and International Studies Georgetown University Jun 15 16, 1978) AD A077 838

PP 266
Utgoff Kathy Classen and Brechling, Frank "Taxes and Inflation" 25 pp Nov 1979, AD A081 194

PP 267
Trost Robert P and Vogel, Robert C "The Response of State Government Receipts to Economic Fluctuations and the Allocation of *Counter Cyclical Revenue Sharing Grants*" 12 pp. Dec 1979 (Reprinted from the Review of Economics and Statistics Vol LXI No 3 August 1979)

PP 268
Thomason James S "Seaport Dependence and Inter State Cooperation *The Case of Sub-Saharan* Africa" 141 pp Jan 1980 AD A081 193

PP 269
Weiss Kenneth G "The Soviet Involvement in the Ogaden War" 42 pp Jan 1980 (Presented at the Southern Conference on Slavic Studies in October 1979) AD A082 219

PP 270
Remnek, Richard, "Soviet Policy in the Horn of Africa The Decision to Intervene," 52 pp., Jan 1980 (To be published in "The Soviet Union in the Third World Success or Failure," ed. by Robert H. Donaldson, Westview Press, Boulder, Co., Summer 1980), AD A081 195

PP 271
McConnell James, "Soviet and American Strategic Doctrines *One More Time*" 43 pp. Jan 1980, AD A081 192

PP 272
Weiss Kenneth G "The Azores in Diplomacy and *Strategy* 1940 1945" 46 pp Mar 1980, AD A085 094

PP 273
Nakada Michael K "Labor Supply of Wives with Husbands *Employed Either Full Time or Part Time*" 39 pp Mar 1980 AD A082 220

PP 275
Goldberg Lawrence "Recruiters Advertising and Navy Enlistments" 34 pp Mar 1980 AD A082 221

PP 276
Goldberg, *Lawrence* "Delaying an Overhaul and Ship's Equipment" 40 pp May 1980 AD A085 095

PP 277
Mangel Marc "Small Fluctuations in Systems with Multiple Limit Cycles" 19 pp Mar 1980 (Published in SIAM J Appl *Math Vol 38 No 1 Feb* 1980) AD A086 229

PP 278
Mizrahi Maurice "A Targeting Problem Exact vs Expected Value Approaches" 23 pp Apr 1980 AD A085 096

PP 279
Walt, *Stephen M* "*Causal Inferences and the Use* of Force A Critique of Force Without War" 50 pp May 1980 AD A085 097

PP 280
Goldberg Lawrence "Estimation of the Effects of A Ship's Steaming on the Failure Rate of its Equipment An Application of Econometric Analysis" 25 pp April 1980 AD A085 098

PP 281
Mizrahi, Maurice M., "Comment on 'Discretization Problems of Functional Integrals In Phase Space'," pp., May 1980

PP 283
Dismukes, Bradford, "Expected Demand for the U.S. Navy to Serve as An Instrument of U.S Foreign Policy Thinking About Political and Military Environmental Factors," 30 pp., April 1980, AD A085 099

PP 284
J. Keilson,* W. Nunn, and U. Sumita,** "The Laguerre Transform," 119 pp., May 1980
*The *Graduate School of Management*, University of Rochester and the Center for Naval Analyses
**The Graduate School of Management, University of Rochester, AD A086 100

PP 285
Remnek, *Richard B.*, "*Superpower Security Interests in the Indian Ocean Area*," 26 pp., Jun 1980 AD A087 113

PP 286
Mizrahi, Maurice M., "On the

PP 286
Mizrahi, Maurice M., "On the WKB Approximation to the Propagator for Arbitrary Hamiltonians," 25 pp., Aug 1980 (Printed in Journal of Math. Phys, 22 (1) Jan 1980)

PP 287
Cope, Davis, "Limit Cycle Solutions of Reaction Diffusion Equations," 325 pp., Jun 1980 AD A087 114

PP 288
Golman, Walter, "Don't Let Your Slides Flip You A Painless Guide to Visuals That Really Aid," 28 pp., Oct 1980

PP 289
Robinson, Jack, "*Adequate Classification* Guidance – A Solution and a Problem," 7 pp., Aug 1980

PP 290
Watson, Gregory H., "Evaluation of Computer Software in an *Operational Environment*," 17 pp., Aug 1980

PP 291
Maddala, G S* *and* Trost, R. P., "Some Extensions of the *Nerlove Press Model*," 17 pp., Oct 1980
*University of Florida

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Thomas, Jr., James A., "The Transport Properties of Binary Gas Mixtures *in Applied Magnetic* Fields," 10 pp., Sept 1980 (Published in Journal of *Chemical Physics* 72 (10), 15 May 1980

PP 293
Thomas, Jr., James A., "Evaluation of Kinetic Theory Collision Integrals Using the Generalized Phase Shift Approach" 12 pp., Sept 1980 (*Printed* in Journal of Chemical Physics 72 (10), 15 May 1980

PP 294
Roberts, Stephen S. "French Naval Policy Outside of Europe," 30 pp. Sept 1980 (Presented at the Conference of the Section on Military Studies, International Studies Association Kiawah Island, S C)

PP 295
Roberts, Stephen S., "An Indicator of Informal Empire Patterns of U S Navy Cruising on Overseas Stations, 1869 1897," 40 pp., Sept 1980 (Presented at Fourth Naval History Symposium, US Naval Academy, 26 October 1979

PP 296
Dismukes, Bradford and Petersen, Charles C., "Maritime Factors Affecting Iberian Security," (Factores Maritimos Que Afectan La Securidad Iberica) 14 pp. Oct 1980

PP 297 – Classified

PP 298
Mizrahi, Maurice M., "A Markov Approach to Large Missile Attacks," 31 pp., Jan 1981

PP 299
Jondrow, James M. and Robert A. Levy, "Wage Leadership in Construction, 19 pp., Jan 1981

PP 300
Jondrow, James and Peter Schmidt*, "On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model," 11 pp., Jan 1981
*Michigan State University

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Jondrow, James M.; Levy, Robert A. and Hughes, Claire, "Technical Change and Employment in Steel, Autos, Aluminum, and Iron Ore," 17 pp., Mar 1981

PP 302
Jondrow, James M. and Levy, Robert A., "The Effect of Imports on Employment Under Rational Expectations," 19 pp., Apr 1981

PP 304
Duffy, Michael K.; Greenwood, Michael J.* and McDowell, John M.**, "A Cross-Sectional Model of Annual Interregional Migration and Employment Growth: Intertemporal Evidence of Structural Change, 1958-1975," 31 pp., Apr 1981
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